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PERFORMANCE AND EMISSION CHARACTERISTICS OF HIGH SPEED DIESEL ENGINE BLENDS WITH CARBON NANOTUBES ADDED ETHANOL-DIESEL

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ABSTRACT

The principle criteria of this experimental work is to study and examine the performance and emission characteristics of a single cylinder 4 stroke KIRLOSKAR AV1 Diesel engine with the carbon nanotubes expansion mixes of ethanol and diesel. The variety in execution parameters and emanations, because of the expansion of nanoparticles was examined by the experimentation. In this work, a 50ppm grouping of carbon nanotube (CNT) was added to the mixes of ethanol and diesel to discover the varieties when contrasted. Absolutely, three unique kinds of mixes were readied, named as E1050CNT (ethanol 10%, diesel 90%,50ppm CNT), E2050CNT (ethanol 20%, diesel 80%,50ppm CNT) and E3050CNT (ethanol 30%, diesel 70%,50ppm CNT), to gauge the execution parameters like Specific fuel consumption(SFC), Brake warm efficiency(BTE) and qualities of emanations like CO, HC, CO2 and NOX at a steady speed of 1500 rpm at different heaps of 3kg, 6kg, 9kg and 12kg to make examination with diesel. At the point, when the outcomes contrasted and diesel the SFC was expanded, BTE is marginally lessened and the emanations like CO, HC and CO2 were diminished, yet NOX was somewhat expanded with the nano-ethanol-diesel mixes. The outcomes from the analysis demonstrates that the coveted states of execution parameters like SFC and BTE were acquired with E10CNT50 mix and a critical abatement in outflows was gotten with E30CNT50 mix. At last, it is prescribed to utilize the nano-ethanol-diesel mixes for a diesel motor as a satisfactory and reasonable elective fuel with no changes.

KEYWORDS: Diesel Engine, Ethanol, Performance, Emissions, Blends & CNT

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Original Article

INTRODUCTION

Now days, the utilization of Diesel motors are very expanded in the divisions like power age, cars, farming, ventures and vast apparatuses due to its better effectiveness, unwavering quality and economy. In the present everyday circumstances, entire world is confronting the two issues all inclusive. One is the quick consumption of ordinary oil fuel assets and another is relentless increment of contamination in nature. When chipping away at diesel motors, it is an intense issue to control the emanations of oxides of nitrogen, because of accomplishing of higher temperatures amid overwhelming burdens. To decrease the air contamination alongside, not including required needs and requests of vitality segments, it is extremely fundamental to go for a substitute

fuel to supplant the non-renewable energy sources. Because of these reasons, the specialists are demonstrating their enthusiasm to discover the odds of delivering interchange fills. For this, the energizers from horticultural biomass and strong waste are the best possible sustainable assets to plan elective fills. Thereby, it is conceivable to lessen the impacts of a dangerous atmospheric deviation, natural contamination, vitality expenses and request of vitality needs. These bio fills could be delivered from squander oils, creature fats, civil strong, plant and backwoods squanders. These bio energizes can be effectively mixed with diesel by including it, specifically volume premise, to make a few mixes for vehicles, home warming necessities and industry prerequisites. The properties of biodiesels are fundamentally the same as diesel and don't contain polluting influences like sulfur and aromatics. Accordingly, these bio fills can be substituted for diesel in diesel motors, specifically by without doing any significant changes and alterations to the motor. Khadijeh Heydari et al. played out a try different things with CNT added diesohol mixes to investigate its outflows and execution on a diesel motor. From their test, the outcomes demonstrate that the Brake warm productivity was expanded by 13.97% with E4B2C60, when contrasted and ordinary diesel. The SFC and temperature of fumes gases were diminished by 11.73 and 1.86%. While alternate discharges like HC, CO were decreased by 31.72 and 5.47%, yet the NOX was raised by 12.22%. Another scientist Ahmed I. El-Seesy directed an exploration of different avenues regarding the mixes of biodiesel, diesel with the added substance multiwall CNT. Their outcomes demonstrated that the BTE was expanded by 16% with MWCNT-B20 mix alongside change in burning, and the emanations like NOX, HC and CO were extensively diminished by 35, 50 and 60%. R. Parthasarathi et al. explored on the diesel motors with the mixes of diesel-ethanol emulsions to discover the outflow qualities and its execution. They got the outcomes similarly as with E40D50, the SFC was diminished and BTE was expanded, yet the HC and NOX discharges were more prominent when contrasted, and diesel and the smoke thickness is lighter and carbon dioxide outflows are lesser.[1-6]

Arul Mozhi Selvan et al. have taken every necessary step on a diesel motor by diesel-biodiesel-ethanol mixes, with added substance, cerium oxide nano molecule. From their examination, it was discovered that by making ultrasonication to the mixes, the steadiness of the mixes is expanding, and to maintain a strategic distance from layer detachment in a mix, added substance - castor oil methyl oil can be utilized. Discharges were diminished, because of the blending of nano particles and enhance the ignition rate. Yanuandri Putrasari et al. additionally played out to try different things with the ethanol-diesel mixes in a volume extent of 2.5, 5, 7.5, and 10 at different burdens [7-10]. Their outcomes demonstrate that by expanding the level of ethanol in the fuel mixes, the diesel motor power was expanded and the SFC, fumes gas temperatures were diminished and the fumes gases like CO, HC and smoke were decreased. S. Gomasta and S. K. Mahla, additionally explored with the diesel-ethanol mixes on a diesel motor and reason that, ethanol is one of the appropriate substitute fuel for a diesel motor. Their outcomes said that when contrasted and diesel the SFC was expanded with ethanol mixes, because of its lower warming worth, BTE was less, yet it is expanding with stack, whereas the discharges like CO, HC were diminishing marginally with increment in blends.[12-15]

FUEL SAMPLES AND ITS PREPARATION

The fuels, utilized as part of this present examination are diesel and ethanol of virtue 99%. In this examination, unadulterated diesel was taken as a base fuel, and a nano molecule carbon nanotubes (CNT) was chosen to make diesel-ethanol-nano mixes. The ethanol was mixed with diesel based on volume and CNT of 50ppm is added to each mix. Absolutely, three mixes were readied, which are E1050CNT (ethanol 10%, diesel 90%, 50ppm CNT), E2050CNT (ethanol 20%, diesel 80%, 50ppm CNT) and E3050CNT (ethanol 30%, diesel 70%, 50ppm CNT). The mixes were made

with the assistance of attractive stirrer. The mixing was done until the point, when the blend was homogeneous. To keep away from the stage, detachment of blend n-butanol was picked as an added substance and 6% of n-butanol was included each mix. To blend the nano particles in the fuel mixes, sonication was finished with the assistance of ultrasonicator for a time of 1 hour for each mix. The ultrasonicator generator delivers high voltage of vitality beats with a recurrence of 20 kHz, in this manner; these nanoparticles will scatter into the fuel mixes effortlessly without settling down. An amount of 50ppm (50mg) CNT is added to each mix.

Table 1: Properties of Tested Fuels

Property	Diesel	Ethanol
Density at 20ºc(kg/m^3)	836	787
Specific Gravity at 20ºc	0.80	0.795
Kinematic viscosity at 40ºc(mm^2/s)	2.7	1.2
Calorific value (kj/kg)	42,500	26,400
Cetane no	50	5-8

EXPERIMENT SETUP AND ITS DESCRIPTION

The analyses were led on the 4-stroke, single chamber, water cooling rapid DI diesel motor as appeared in the figure to assess its execution and emanation attributes. The particulars of the tried motor setup are introduced in Table 2. A rope brake dynamometer was organized to stack the motor to discover its execution at different burdens. The rate of stream of the fuel was controlled by watching the time taken for fuel utilization of a volume of 10cc through a burette with stopwatch. The motor fumes gas discharge attributes like carbon monoxide (CO), unburned hydro carbons (HC), carbon dioxide (CO2), and oxides of nitrogen (NOX) were estimated by utilizing an INDUS 5gasanalyzer.

Figure 1: Experimental Setup

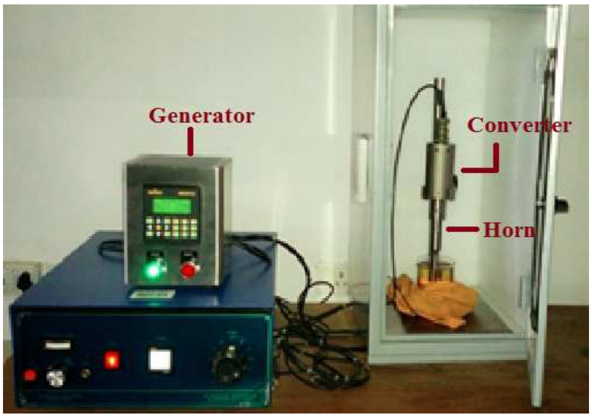

Figure 2: Ultrasonicator

Figure 3: INDUS 5 Gas Analyzer

Table 2: Technical Specifications of the Engine

Type of Engine	**Four Stroke Vertical, Water Cooled, Single Cylinder, High Speed Diesel Engine**
Model	Kirloskar AV1
Cylinder Bore x Stroke (mm)	80 mm X 110 mm
Compression ratio	16.5:1
Brake power	3.75Kw
Speed	1500rpm
Injection pressure	200 bar
Load type	Mechanical

EXPERIMENTAL PROCEDURE

The examination was led on the motor with diesel and mixes of ethanol E1050CNT, E2050CNT and E3050CNT. At first, the heap test was directed with all the test tests at the heaps of 0, 3, 6, 9 and 12kg. The time taken for 10cc of fuel utilization was noted down with the assistance of stop look for each heap for every one of the examples, and at the same time, comparing readings of fumes outflows like CO, HC, CO2 and NOX were likewise noted down and set to zero preceding each cycle. Every one of the readings was organized in detail to figure the brake warm effectiveness, particular fuel utilization. Later, the diagrams were plotted amongst burdens and outflows execution parameters for similar examination.

RESULTS AND DISCUSSION

Specific Fuel Consumption (SFC)

Specific fuel consumption is one of the execution parameter, which gives the amount of fuel expended at different conditions. It can be figured by doing the proportion of mass stream rate of fuel in kg per kwhr and brake control in kw. The figure 4 demonstrates the pattern of SFC concerning load. From this chart, it is brought up that among every one of the mixes, the SFC is expanding with expanding the level of ethanol when contrasted, and diesel at all the distinctive burdens. It is predominantly because of the lesser calorific estimation of ethanol and diesel mixes. Among every one of the mixes with E10CNT50, the SFC is somewhat diminished than diesel. The slightest SFC is with E10CNT50 mix at 12 kg stack by an estimation of 0.325 kg/kwhr, while for the diesel, it is 0.351kg/kwhr.

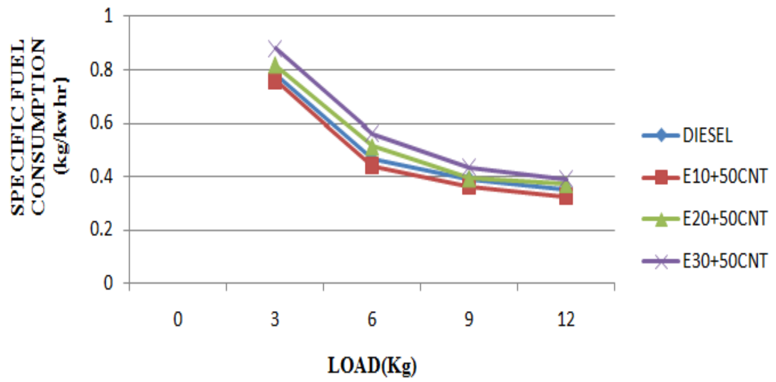

Figure 4: Specific Fuel Consumption Vs Load

Brake Thermal Efficiency (BTE)

The brake specific fuel consumption is also an important parameter for evaluating the engine performance in narrow manner. It can be found out by doing the ratio of brake power and energy, produced by consuming the fuel. From the graph plotted between load and brake thermal efficiency for diesel and nano-ethanol-diesel blends, we can say that the BTE is slightly fluctuating with increase in percentage of ethanol in blends for all the loads. But, it is increased with increasing the load for all the tested fuel samples. The maximum efficiency is obtained with E10CNT50 at 12 kg load when compared with both diesel and remaining blends and the respected values are 24.67, 24.09, 25.48, 25.61%.

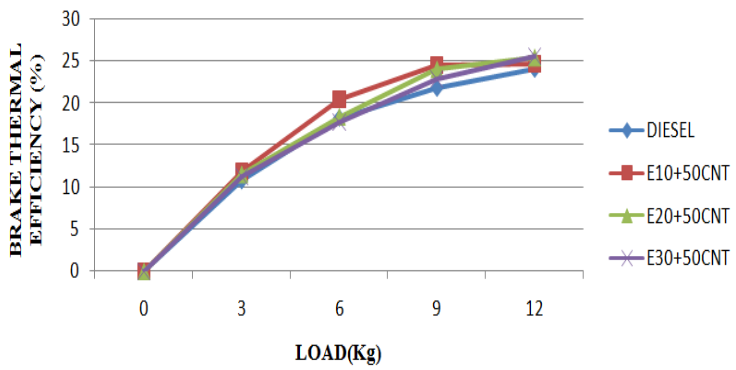

Figure 5: Brake Thermal Efficiency Vs Load

Carbon Monoxide (CO)

The carbon monoxide is the harmful emission among the other exhaust gases. The CO emission is mainly because of the incomplete combustion. The graph is plotted between CO and load for all the tested fuel samples. With the help of this graph, we can clearly identify that the CO emissions are more with diesel than nano-diesel-ethanol blends at all the loads. Another point noticed was that, with increasing ethanol percentage in diesel, the CO is decreasing. Therefore, lesser CO emissions are obtained for the blend E30CNT50 when compared with diesel and other blends, and the respected values are.012, 0.014, 0.013 and 0.013%. But, at 12kg load, the CO emissions are less when compared with other load conditions for all the tested fuels.

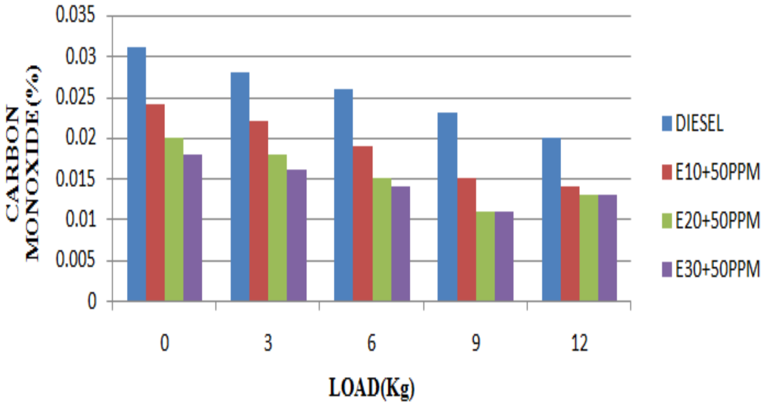

Figure 6: Carbon Monoxide Vs Load

Carbon Dioxide (CO_2)

The carbon dioxide is the green house gas, so our wish is to get the lower values than diesel among blends of nano-ethanol-diesel. The graph is plotted between load and CO_2 for various blends and at different loads, to know the trends of carbon dioxide emission. From the graph, it is observed that the CO_2 emissions are increasing with increase in load. But, CO_2 is reducing with increasing the quantity of ethanol in blends. Among all the test samples, the least CO_2 is for E30CNT50 when compared with diesel, and remaining blends at no load condition. The respected values of CO_2 at this condition are 2.5, 1.6, 1.4 and 1% for diesel, E10, E20 and E30 nano blends. Due to the mixing of nano particles in the blends of ethanol and diesel, the CO_2 is decreasing.

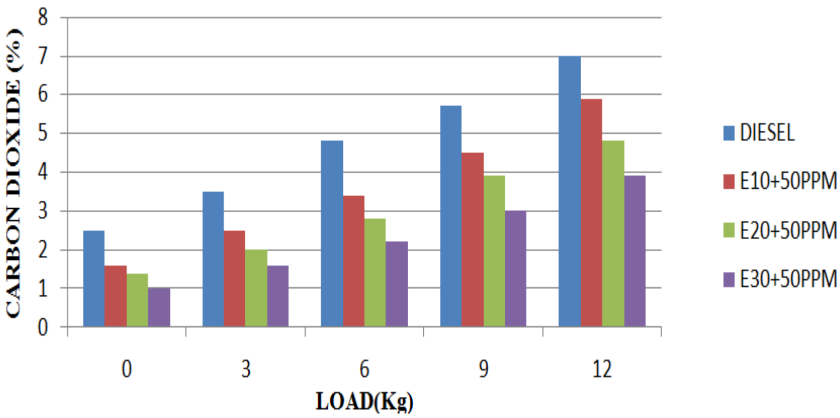

Figure 7: Carbon Dioxide Vs Load

Hydro Carbon (HC)

The unburnt hydrocarbons are the emissions, mainly caused due to lack of oxygen in the combustion chamber. The graph was plotted between HC and loads for the tested fuel samples to analyse its quantity at various conditions. From this experiment, the graph shows that the HC emissions first decreases with increase in load up to half load condition, and then increases up to full load. But, HC is reducing with increasing the quantity of ethanol in blends. The least HC is occurred with E30CNT50 at half load condition among all the fuel samples, and the maximum HC is for diesel at no load condition when compared with all the blends. The respected values of HC for diesel, E10, E20, E30 nano blends at the 6kg load are 32, 23, 16 and 10 ppm.

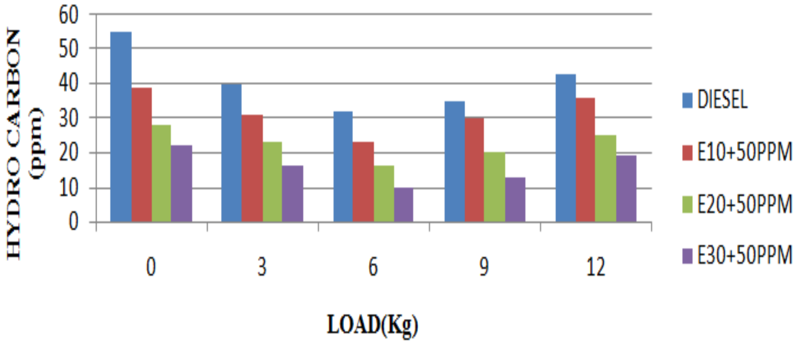

Figure 8: Hydro Carbon Vs Load

Oxides of nitrogen (NO_X)

The oxides of nitrogen are mainly due to the higher temperatures of the exhaust gases. Therefore, the NO_X emissions are more with ethanol blends due to its large heating value. By adding the ethanol to the diesel, the calorific value is decreased, so that consumption of fuel increased, thereby the temperatures get raised. The graph is plotted between the oxides of nitrogen and load with diesel and nano-ethanol-diesel blends, to make comparison. From the columns of graph, it is observed that the NO_X emissions are nil at no load condition for all the test samples. But, at the remaining loads NO_X is increasing with increasing the quantity of ethanol in the blends when compared with diesel. But another important thing here observed is, with E10+50CNT, the NO_X emissions are less at all loads when compared with diesel, E20, E30 nano blends, the respected values at 3 kg load are 30, 35, 40 and 50 ppm.

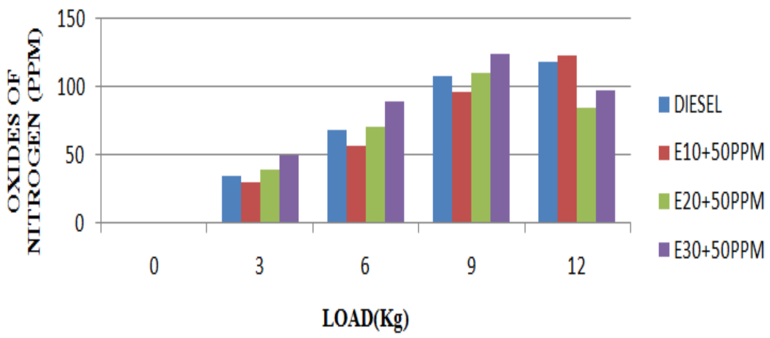

Figure 9: Oxides of Nitrogen Vs Load

CONCLUSIONS

In this trial, ethanol and diesel mixes with an extent of E10, E20 and E30 alongside nano molecule, and carbon nano tubes is utilized to decide the yield parameters like SFC, BTE and fumes gas attributes of a four stroke single barrel fast diesel motor. An amount of 50 ppm of carbon nano tubes (CNT) is added to all the ethanol-diesel mixes at a consistent motor speed of 1500 rpm under the heaps of 0, 3, 6, 9 and 12kg. An added substance, n-butanol is added to evade the layer detachment between the diesel ethanol mixes. From the investigation, the accompanying outcomes are acquired.

- The particular fuel utilization is somewhat more with the diesel-ethanol-nano mixes than diesel. SFC is somewhat expanding with increment in ethanol amount in diesel of a mix. Be that as it may, the SFC is diminishing with expanding the heap for all the tried fuel tests. The slightest SFC is gotten with E10CNT50 mix at 12 kg stack by an estimation of 0.325 kg/kwhr, though for the diesel it is 0.351kg/kwhr.

- The brake warm effectiveness is expanding with expanding the heap for all the tried fuel tests. Be that as it may, it is marginally fluctuating with expanding the amount of ethanol in mixes. Generally, it is diminishing with increment in extent of ethanol. Be that as it may, the most extreme BTE is gotten for E10+50CNT at 12 kg stack among every one of the examples.
- The carbon monoxide emanation is decreasing with expanding the both load and level of ethanol in the mix proportion. The slightest CO discharges are acquired with E30+50CNT at higher burdens.
- The carbon dioxide is expanding with expanding the heap for all the tried fuel tests. Be that as it may, it decreases with rise of the extent of ethanol in the mix proportion. The base CO2 outflows are acquired at no heap condition with all the tried fills, and when contrasted among different burdens, it is least for E30+50CNT.
- The unburnt hydrocarbons are significantly diminished with expanding the extent of ethanol in the mixes. Yet, the HC is much diminished at half load conditions. The base HC is acquired at 6 kg stack for E30+CNT test.
- The oxides of nitrogen are zero at no heap condition for all the test tests. Be that as it may, the NOX is expanding with expansion in both load and proportion of ethanol in the mixes. NOX is exceptionally expanded at more prominent burdens.

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